AMENDMENTS TO THE SPECIFICATION

Please replace Paragraphs [0006], [0008], [0013], [0020], [0022], [0023], [0024], [0025], [0027], [0028], [0030], [0033] and [0034] with the following paragraphs rewritten in amendment format:

[0006] In accordance with a first aspect of the present invention, a fuel cell is provided. The fuel cell includes a pair of MEA[[']]s separated from each other by a distance. Each of the MEA[[']]s has an anode side and a cathode side. A bipolar plate assembly is located between the anode side of one of the pair of MEA[[']]s and the cathode side of the other of the pair of MEA[[']]s. The bipolar plate assembly has a first sub-plate with a flow channel which is open to the anode side of the one of the pair of MEA[[']]s. The bipolar plate assembly also has a second sub-plate with a flow channel which is open to the cathode side of the other of the pair of MEA[[']]s. The first sub-plate and the second sub-plate are nested together to form a coolant flow channel between the first and second sub-plates.

[0008] In accordance with yet another aspect of the present invention a method of operating a fuel cell having a plurality of adjacent MEA[[']]s is provided. The method includes passing oxygen through a flow path in communication with a cathode side of the MEA. Hydrogen is passed through a flow path in communication with an anode side of the MEA. Each of the hydrogen and oxygen flow paths has a height dimension. Coolant is also passed through a flow path having a height dimension which is substantially aligned with the height dimension of the hydrogen flow path, the oxygen flow path, or both.

[0013] FIG. 3 is an enlarged, partial, cross-sectional view of a preferred bipolar plate assembly located against the sides of adjacent MEA[['']]s;

[0020] Referring to FIG. 2, it can be seen that each of the bipolar plates 12, 14, and 16 is actually a bipolar plate assembly 60 made up of two sub-plates 62, 64. This bipolar plate assembly 60 is the same for each of the bipolar plates 12, 14, and 16 of FIG. 1. The sub-plates 62, 64 include serpentine channels 66, 68 forming a flow path in a flow field in the outer or external surfaces 62e, 64e of the bipolar plate assembly 60. <u>Each serpentine channel 66, 68 has a land region 67, 69 adjacent thereto.</u> In addition, the various channels 66, 68 of the sub-plates result in opposing channels 70 on the internal faces 62i, 64i of the thin metal sub-plates 62 and 64, respectively. <u>These opposing channels 70 are contained within the land regions 67, 69.</u> Thus, when the sub-plates are nested together a flow path (or channel) 70 for a coolant flow field is formed between the interior surfaces 62i, 64i of the nested sub-plates 62, 64. This is explained in more detail with respect to specific preferred embodiments described hereinafter.

[0022] Each of the sub-plates 62, 64 has been stamped to form the flow channels 66, 68 and 70 when the plates are nested together to form the bipolar plate assembly 60. The flow channels include oxygen flow channels 68 for the cathode side 8c, 10c of the MEA[['']]s 8, 10, hydrogen flow channels 66 for the anode side 8a, 10a and coolant flow channels 70. <u>A first group of land regions 67 are located adjacent to the hydrogen flow channels 66 and a second group of land regions 69 are located adjacent to the oxygen flow channels 68. The land regions 67, 69 contain the coolant flow channels 70. More specifically, the first group of land regions 67 contains both the coolant flow channels 70 and the oxygen flow channels 68. The second group of land</u>

regions 69 contains both the coolant flow channels 70 and the hydrogen flow channels 66. Each of the hydrogen, oxygen and coolant flow channels 66, 68 and 70, respectively, has a height which is substantially the same as the height of the other flow channels. As used herein, height refers to the vertical direction as seen in the drawings. The space between the MEA[[']]s created by the bipolar plate assembly 60 is substantially the same as the height of each of the flow channels 66, 68, 70. Preferably, the space between the MEA[[']]s is no more than about 1.3 times the height of one of the flow channels; more preferably, no more than 1.2 times; and even more preferably, no more than 1.1 times.

[0023] The external surfaces 62e, 64e of each of the sub-plates 62, 64 includes a channel 66, 68 providing the hydrogen flow path or the oxygen flow path, respectively. Thus, the oxygen and hydrogen flow paths are open against the anode and cathode sides of the MEA, 8a, 10a and 8c, 10c respectively. The MEA 8, 10 typically includes a diffusion media 9, 11 to enable the oxygen and hydrogen to flow into the MEA 8, 10 across the land ~~areas~~ regions 67, 69 created by the flow sub-plates 62, 64; thereby enabling the gaseous reactants to contact the entire face of the MEA 8, 10. Each of the land regions 67, 69 has a width generally twice the width of the flow channel 66, 68 contained therein. This creates an effective lateral distance over which the fluids must travel in order to use the entire face of the MEA 8, 10. This distance, commonly referred to as diffusion distance, is generally one-half of the distance between the edges of laterally adjacent like flow channels.

[0024] The inner surface 62i, 64i of each of the sub-plates 62, 64 face toward each other and form the coolant flow path 70 therebetween. The coolant flow path 70 is

created by nesting the sub-plates 62, 64 together. It is preferred that the height dimension of the coolant flow path 70 is substantially within (i.e., not extending up or down past either end except in an insubstantial way) the height dimension of at least one of the oxygen and hydrogen flow paths 66, 68 or that the height dimension of the coolant flow path is substantially aligned with the height dimension of at least one of the oxygen and hydrogen flow paths. All three of the flow paths 66, 68, 70 of this embodiment are provided within a height dimension which is substantially the same as the height of each of the other flow paths. It can be seen that the distance between the MEA[[']]s 8, 10 is substantially unaffected by the height dimension of the coolant flow path 70, since the height dimension of the overall plate assembly is substantially the same as the height dimension of the oxygen flow path 68 and the hydrogen flow path 66, together.

[0025] Referring to FIG. 4, an alternative preferred embodiment of a bipolar plate assembly 160 formed from nested sub-plates 162, 164 is illustrated. This alternative preferred embodiment is similar in many respects to that of the previous preferred embodiment 60. However, the plates 162, 164 are nested so that the flow path channels 166, 168 which form the hydrogen and oxygen flow paths are centered in the ~~wider coolant flow path channel 170~~ <u>land regions 167, 169</u>. This creates a coolant flow path channel 170 along each side of the hydrogen and oxygen flow path channels 166, 168. Thus, for each oxygen flow path 168 and hydrogen flow path 166, there are two coolant flow paths 170. Although the cross-sectional area of each of the coolant flow paths 170 is smaller than that of the oxygen flow path 168 and the hydrogen flow path 166, the surface area of the combined coolant flow paths 170 (or flow field) is

greater than the surface area of the of the oxygen flow path 168 and the hydrogen flow path 176 and of the coolant flow path 70 of the previous embodiment. In this case, the surface area of the coolant flow path 170 is about 1.5 times the surface area of each of the oxygen flow path 168 and the hydrogen flow path 166. Increasing the surface area of the coolant flow path 170 provides for more effective heat transfer.

[0027] Referring to FIG. 5, another alternative preferred embodiment of a bipolar plate assembly 260 of the present invention is illustrated. In this embodiment, the upper sub-plate 262 is formed with a series of hydrogen channels 266 spaced relatively far apart; forming relatively wide land regions 267, 269. The lower sub-plate 264 includes a pair of narrower channels that nest between the hydrogen flow channels 266 in the wider channels 270 of the upper sub-plate created by the wide land regions 267. This allows three separate channels 268, 270, 268 to be formed in this area when the sub plates 262, 264 are nested together. The two of these channels 268 which are open to the cathode side of the MEA provide oxygen flow paths. The third channel 270 is confined between the two sub-plates 262, 264 and provides a coolant flow path 270. In order to accommodate the three channels 268, 270, 268, the land regions 267 are generally the width of the three channels 268, 270, 268 combined. The hydrogen flow path 266 is provided adjacent to these three flow paths which is open to the anode side of the MEA. This configuration also allows the diffusion distance for the cathode side to be similar to that of a conventional configuration.

[0028] As with each of the embodiments previously described above, the oxygen and hydrogen travel[[s]] laterally through the diffusion media 9, 11 to contact the MEA over its entire surface. This embodiment takes advantage of the fact that the

hydrogen can travel more readily through the diffusion media 9, 11 than the oxygen. As a result, the hydrogen can more readily travel further laterally to provide effective performance over a larger surface area of the MEA 8, 10. In the previous embodiments, both the hydrogen and oxygen needed to travel the same distance; about one-half the distance of the land area in contact with the sides of the MEA 8, 10. In this case, the hydrogen needs to travel laterally about one-half of the distance of the large land area against the anode side of the MEA 8a, 10a (that is, the land area separating the hydrogen flow paths). In contrast, the larger oxygen molecule needs to travel only about one-half of the smaller land area separating the oxygen flow paths. This means that the oxygen needs to only travel laterally about one-third of the distance that the hydrogen needs to travel through the diffusion media 9, 11.

[0030] The forming operation provides each of the respective channels 66, 68 and 70 with a height dimension. Nesting substantially aligns the height dimension of the cooling channel 70 with the height dimension of the hydrogen flow channel 66, the oxygen flow channel 68, or both. The cooling of flow channel 70 can be substantially aligned without necessitating that it stop and start substantially at the same height location. The channels 66 and/or 68 are aligned when the cooling flow channel 70 does not extend past the stopping or starting height of the corresponding flow channel(s) 66 and/or 68, other than in an insubstantial way. In addition, nesting the sub-plates 62, 64 together preferably locates the height dimension of the closed channel to substantially within the height dimension of the open channel 66, adapted to face the anode side or the open channel 68 adapted to face the cathode side. Similarly, the distance between

a pair of adjacent MEA[[']]s 8, 10 is substantially unaffected by the height dimension of the coolant flow channel 70.

[0033] A preferred process for operating a fuel cell having a preferred bipolar plate assembly 60 includes passing oxygen through a flow path 68 in communication with a cathode side of the MEA 10c. In addition, hydrogen is passed through a flow path 66 in communication with an anode side of an adjacent MEA 8a. Each of the oxygen flow path 68 and the hydrogen flow path 66 have a height dimension. Preferably, these height dimensions are substantially aligned with each other. Coolant is also passed through a flow path 70 having a height dimension which is substantially aligned with the height dimension of the hydrogen flow path 66, the oxygen flow path 68, or both. Similarly, the distance between a pair of adjacent MEA[[']]s 8, 10 is substantially unaffected by the height dimension of the coolant flow path 70. Instead it is driven by the height of the hydrogen flow path 66, and/or the oxygen flow path 68 and/or the location of their corresponding height dimensions.

[0034] As exemplified by the bipolar plate assembly 260 of FIG. 5, the method of operation also[[,]] preferably includes passing the hydrogen through a first effective lateral distance of a diffusion media 9, 11; and passing the oxygen along a second effective lateral distance of a diffusion media 9, 11 which is less than that of the first effective lateral distance. Many other process variations are possible. For example, as seen with the embodiment of FIG. 4, the coolant is passed through a flow path that includes a plurality of flow channels 170. This embodiment also exposes the coolant to an external surface area which is greater than an external surface area of the oxygen flow path 168 and/or the hydrogen flow path 166. Further, the flow path 170 for the

coolant passes the coolant along a pair of opposite lateral sides of a channel of the cathode flow path 168 and/or of the anode flow path 166.